

**CALPUFF Predictions of the
1-hour Sulfur Dioxide Impacts due to
Emissions from the Portland Generating Station**

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Division of Air Quality
New Jersey Dept. of Environmental Protection**

Introduction

This report is an addendum to and supplements the results of the previous modeling analyses submitted in support of New Jersey's May 12, 2010 Section 126 petition to the United States Environmental Protection Agency (USEPA). The final rule for the new 1-hour primary National Ambient Air Quality Standard (NAAQS) for sulfur dioxide was promulgated June 2, 2010 (75 Fed. Reg. 39,633 (July 12, 2010)) and becomes effective August 23, 2010. The previous results of CALPUFF modeling analyses evaluated ambient sulfur dioxide (SO₂) concentrations in the vicinity of the Portland Power Plant and compared the results to the 3-hour and 24-hour SO₂ NAAQS. In this report the results from three modeling scenarios for SO₂ emissions from the Portland Power Plant are provided: 2002 meteorology/allowable emissions, 2002 meteorology/2002 actual emissions, and 2003 meteorology/allowable emissions and compared to USEPA's new one-hour SO₂ standard of 196 ug/m³. Only SO₂ emissions from the Portland Power Plant are included in this evaluation. Hence, the predicted violations of the SO₂ NAAQS are caused solely by the plant.

Modeling Methodology

Modeling of the Portland Generating Plant was performed with the latest EPA approved version of the CALPUFF modeling suite: CALMET/CALPUFF Version 5.8, Level 07063 and CALPOST Version 5.6394, Level 070622. A complete description of the modeling methodologies for the three different scenarios can be found in the following Exhibits of the May 12, 2010 Section 126 Petition:

- 2002 meteorology/allowable emissions - "CALPUFF Modeling Analysis of the Sulfur Dioxide and PM_{2.5} Impacts due to Emissions from the Portland Generating Station" (July 14, 2009) (Exh. 7);
- 2002 meteorology/2002 actual emissions - "CALPUFF Modeling Analysis of the Sulfur Dioxide Impact of 2002 Actual Sulfur Dioxide Emissions from the Portland Generating Station" (February 24, 2009) (Exh. 8);
- 2003 meteorology/allowable emissions - Bowman, J. Thomas, "Air Quality Modeling for the New Jersey Department of Environmental Protection" (January 2009) (Exh. 9).

The 2003 meteorology/allowable emission scenario modeling analysis used a more extensive meteorological database covering a larger area than what was available for the 2002 meteorology scenarios. Therefore, in order to evaluate the regional extent of the predicted violations due to emissions from the Portland Power Plant, a Cartesian receptor grid consisting of 10,500 receptors with a 750m spacing covering an area of 75km X 80km was used. CALPUFF was rerun with the new receptor grid. No other changes to the 2003 modeling methodology were made.

1-Hour SO₂ Post Processing

Atmospheric dispersion models will require a post-processor that can calculate the design concentrations based on the form of the new 1-hour SO₂ NAAQS (99th percentile of the annual distribution of maximum daily 1-hour concentrations). The current version of the CALPOST post-processor for the CALPUFF model is not capable of handling the format of the new standard to determine violations.

Therefore, for this analysis, manual processing of the CALPUFF model concentration output files was required. To determine the concentrations at each receptor in the modeling domain, CALPOST was setup to calculate the maximum 1-hour impact at each receptor for each day. This required CALPOST to be run 364 times (once for each day in the available meteorology) to generate a years worth of daily maximum 1-hour concentrations. Each output file was entered into a spreadsheet. A concentration in the form of the 99th percentile of the daily maximum 1-hour concentrations at each receptor in the domain was calculated using the spreadsheet. This process was repeated for each of the modeling scenarios referenced above.

1-Hour SO₂ Modeling Results

2002 Meteorology/Allowable Emissions

For the 2002 allowable emissions modeling, the maximum predicted 99th percentile daily 1-hour concentration (3,455 ug/m³) occurs across the Delaware River from the Portland Power Plant in New Jersey. The results of the modeling are given in Table 1. The maximum 1-hour SO₂ concentration predicted was 15,273 ug/m³. The maximum 99th percentile daily 1-hour concentration predicted was 3,455 ug/m³, over seventeen times the 1-hour SO₂ NAAQS of 196 ug/m³. At the receptor with the maximum 99th percentile daily 1-hour concentration there were 39 days exceeding the SO₂ NAAQS (i.e., at least one 1-hour concentrations during the day above 196 ug/m³).

Figure 1 displays the 99th percentile daily 1-hour concentrations for the 2002 allowable emissions as isopleths. In addition, the 3-hour SO₂ NAAQS violations from the previous modeling are overlaid as a shaded area for reference. From the figure it can be seen that the violations of the new 1-hour SO₂ NAAQS are predicted to occur at every receptor in the 9 km by 10 km domain as a result of allowable SO₂ emissions from the Portland Power Plant.

Table 1. Predicted 1-Hour Sulfur Dioxide Concentrations with 2002 Allowable Emissions ^(a)

Averaging time	Maximum Impact (ug/m³)	Maximum 99th Percentile Impact (ug/m³)	Maximum Number of Days Above NAAQS	NAAQS (ug/m³)
1-hour	15,273	3,455 ^(a)	39	196

a. Includes no SO₂ background concentrations or emissions from other facilities.

2002 Meteorology/Actual Emissions

As in the 2002 allowable emissions modeling, the 2002 actual emissions modeling predicted the maximum 99th percentile daily 1-hour concentration to occur across the Delaware River from the Portland Power Plant in New Jersey. The maximum 99th percentile daily 1-hour predicted concentration of 2,194 ug/m³ is more than ten times the 1-hour NAAQS. The results of the modeling are given in Table 2. The maximum 1-hour SO₂ concentration predicted was 6,740 ug/m³. At the receptor with the maximum 99th percentile daily 1-hour concentration, there were 27 days exceeding the SO₂ NAAQS (i.e., at least one 1-hour concentrations during the day above 196 ug/m³).

Figure 2 displays the 99th percentile daily 1-hour concentrations for the 2002 actual emissions as isopleths. In addition, the 3-hour SO₂ NAAQS violations from the previous modeling are overlaid as a shaded area

for reference. From the figure it can be seen that the violations of the new 1-hour SO₂ NAAQS are predicted to occur at every receptor in the 9 km by 10 km domain as a result of actual SO₂ emissions from the Portland Power Plant.

Table 2. Predicted 1-Hour Sulfur Dioxide Concentrations with 2002 Actual Emissions ^(a)

Averaging time	Maximum Impact (ug/m³)	Maximum 99th Percentile Impact (ug/m³)	Maximum Number of Days Above NAAQS	NAAQS (ug/m³)
1-hour	6,740	2,194 ^(a)	27	196

a. Includes no SO₂ background concentrations or emissions from other facilities.

2003 Meteorology/Allowable Emissions

The 2003 allowable emissions modeling predicted a maximum 99th percentile daily 1-hour concentration of 2,468 ug/m³. This impact occurred on elevated terrain approximately 1-km across the Delaware River from the Portland Power Plant in New Jersey and is over twelve times the 1-hour SO₂ NAAQS of 196 ug/m³. The results of the modeling are given in Table 3. The maximum 1-hour SO₂ concentration predicted was 18,643 ug/m³. At the receptor with the maximum 99th percentile daily 1-hour concentration there were 63 days exceeding the 1-hour SO₂ NAAQS (i.e., at least one 1-hour concentrations during the day above 196 ug/m³).

Figure 3 displays the 99th percentile daily 1-hour concentrations for the 2003 allowable emissions as isopleths. Figure 3 is based on the results of revised CALPUFF modeling using a 75km X 80km receptor grid to determine the aerial extent of violations caused by the Portland Power Plant. From the figure it can be seen that violations occur across four counties in New Jersey: Hunterdon County, Morris County, Sussex County and Warren County.

Table 3. Predicted 1-Hour Sulfur Dioxide Concentrations with 2003 Allowable Emissions ^(a)

Averaging time	Maximum Impact (ug/m³)	Maximum 99th Percentile Impact (ug/m³)	Maximum Number of Days Above NAAQS	NAAQS (ug/m³)
1-hour	18,643	2,468 ^(a)	63	196

a. Includes no SO₂ background concentrations or emissions from other facilities.

Figure 1. CALPUFF Predictions of the 99th Percentile 1-Hour Sulfur Dioxide and 3-Hour Sulfur Dioxide Impacts due to 2002 Allowable Emissions from the Portland Power Plant

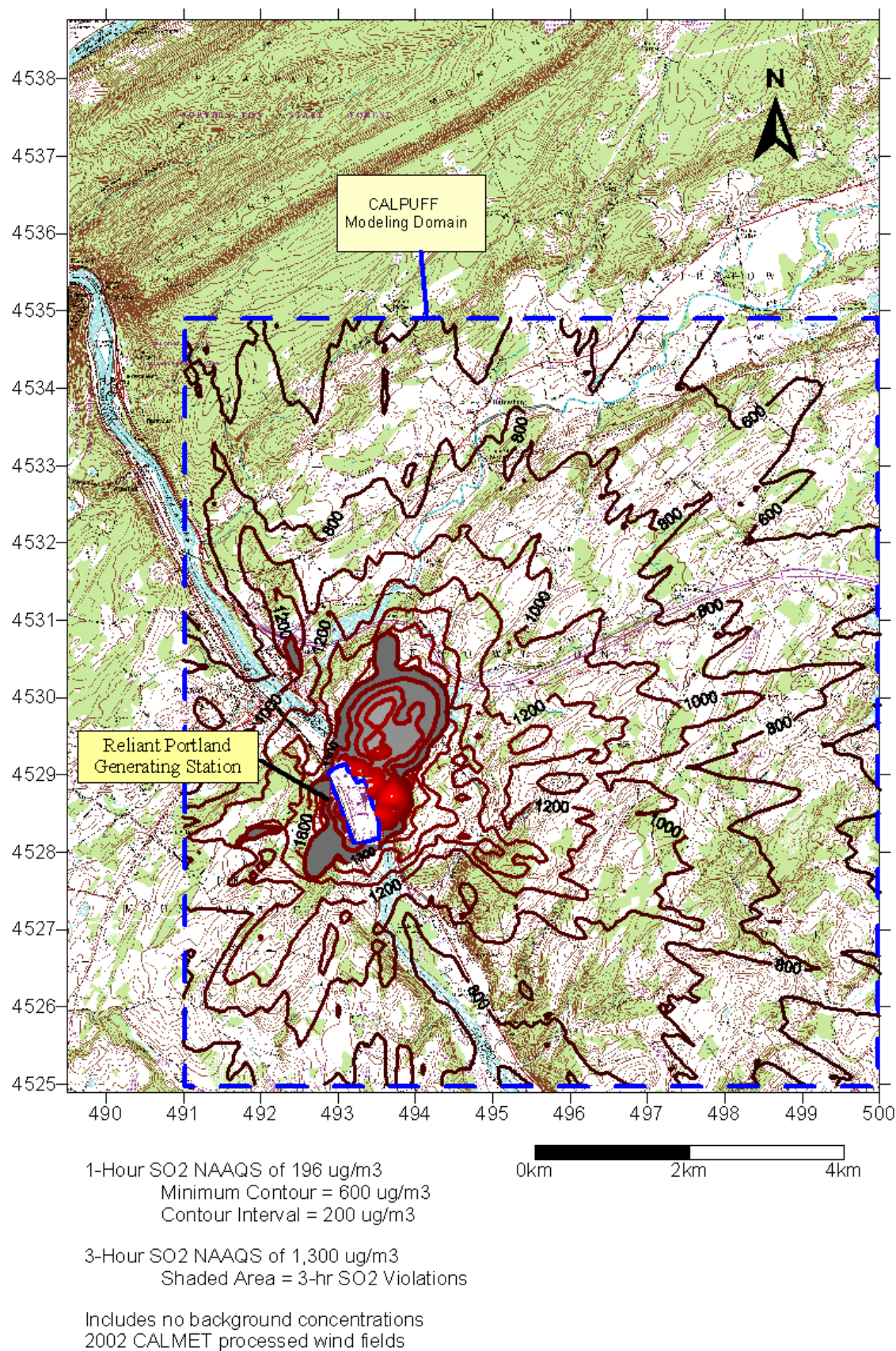
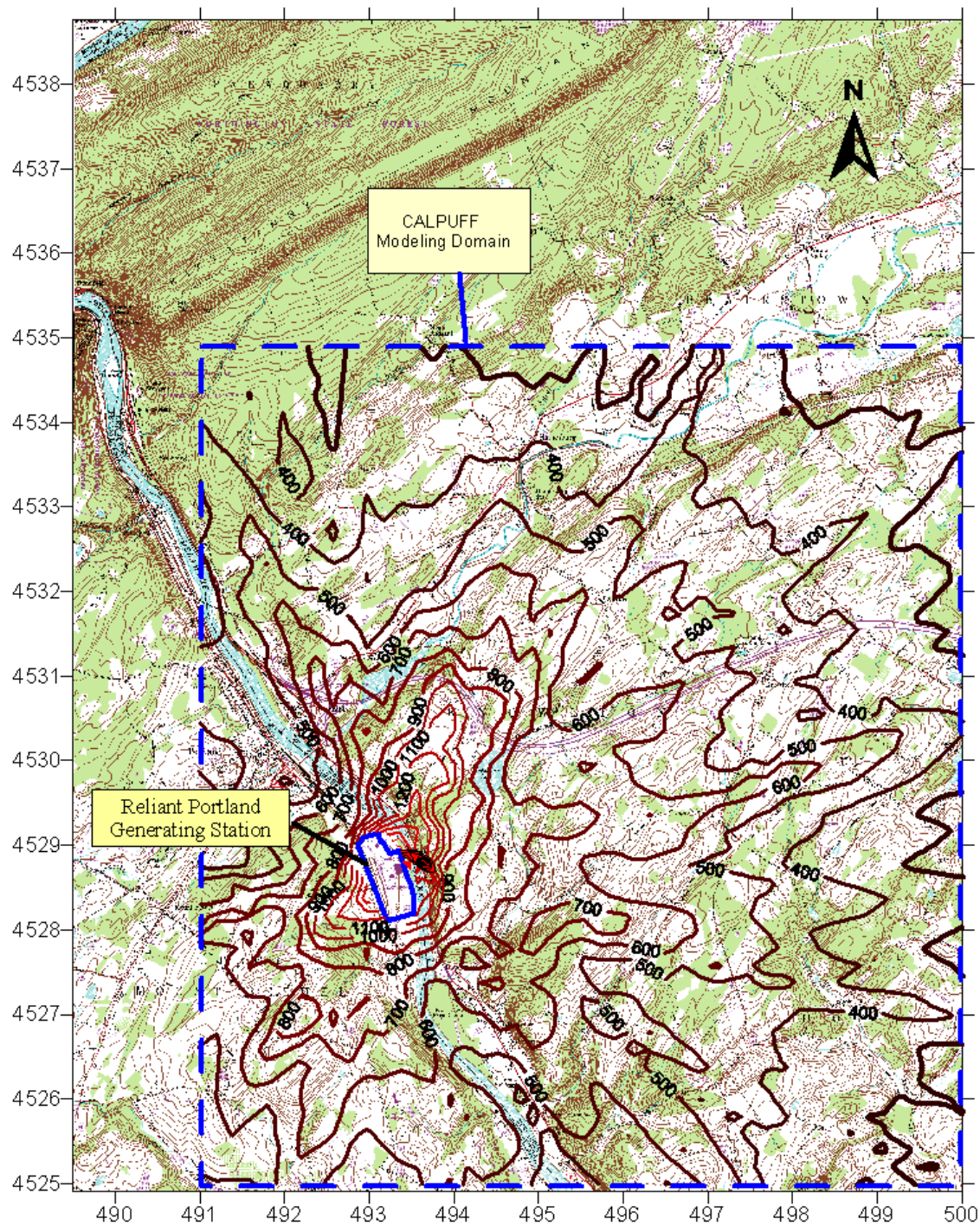


Figure 2. CALPUFF Predictions of the 99th Percentile 1-Hour Sulfur Dioxide and 3-Hour Sulfur Dioxide Impacts due to 2002 Actual Emissions from the Portland Power Plant



1-Hour SO₂ NAAQS of 196 ug/m³
 Minimum Contour = 300 ug/m³
 Contour Interval = 100 ug/m³

0km 2km 4km

3-Hour SO₂ NAAQS of 1,300 ug/m³
 Red Shaded Area = 3-hr SO₂ Violations

Includes no background concentrations
 2002 CALMET processed wind fields

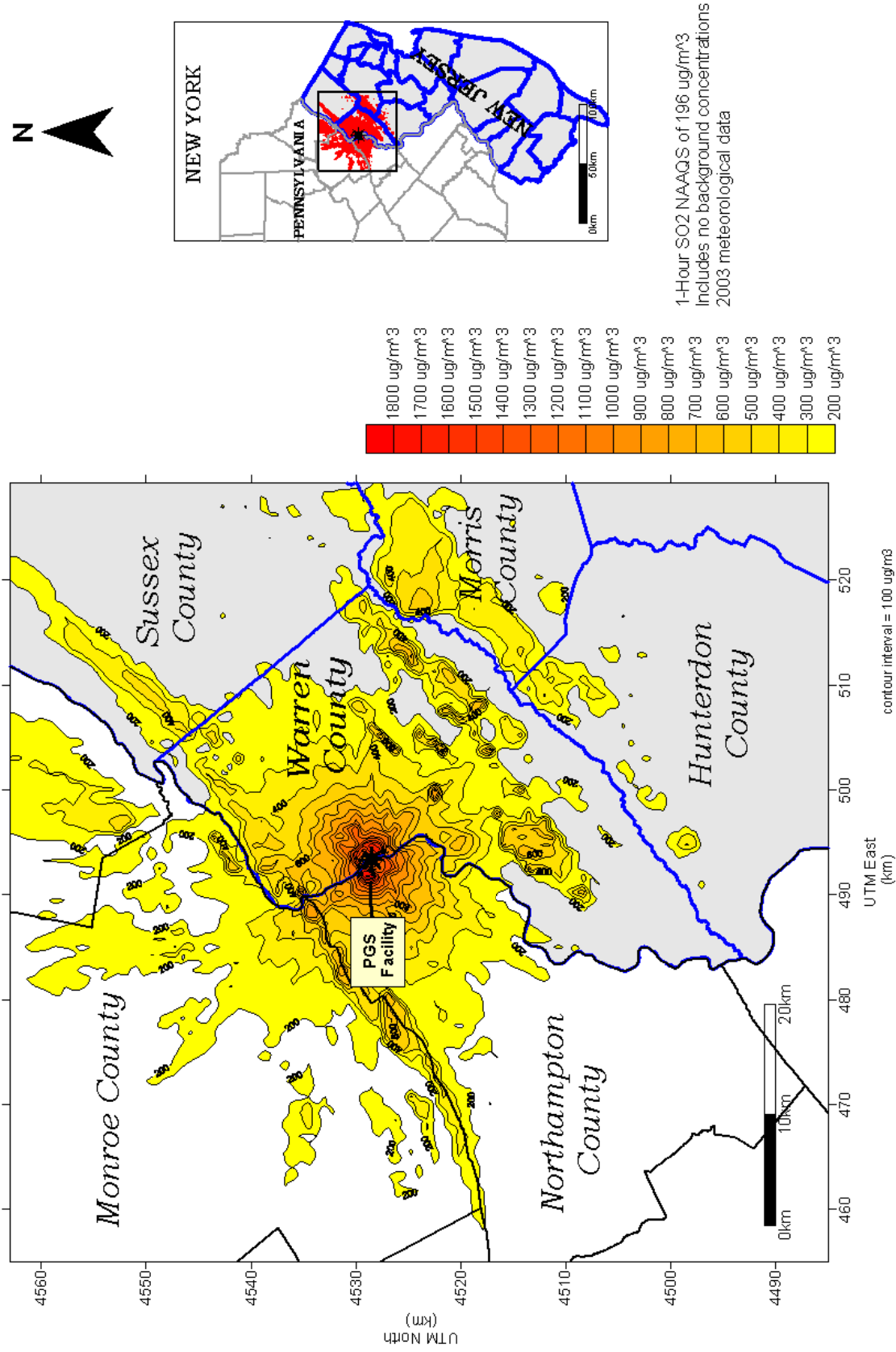


Figure 3. CALPUFF Predicted Violations of the 1-Hour Sulfur Dioxide NAAQS (99th Percentile)
Impacts due to Allowable Emissions from the Portland Power Plant